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Ninth New Collegiate Dictionary

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MERRIAM-WEBSTER INC., Publishers
Springfield, Massachusetts, U.S.A.



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(ACLM/"derived from" AND ACLM/"polynucleotide"): 345 patents.

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ACLM/"derived from" and aclm/"polynucleotide"

PAT. NO.	Title
1 6,667,155	Carrier for gene detection and its use for detecting validity of interferon therapy
2 6,653,075	Random domain mapping
3 6,649,371	Potassium channel KCNQ5 and sequences encoding the same
4 6,645,933	Receptor ligand VEGF-C
5 6,645,746	Carbonyl reductase, gene thereof and method of using the same
6 6,642,375	Fluorescent substances
7 6,642,052	Efficient generation of adenovirus-based libraries by positive selection of adenoviral recombinants through ectopic expression of the adenovirus protease
8 6,632,631	Methods for the identification of inhibitors of homocitrate synthase as antibiotics
9 6,627,193	Methods and compositions for control of blood coagulation
10 6,613,583	Electrochemiluminescent label based on multimetallic assemblies
11 6,610,506	Transferrin binding proteins of Pasteurella haemolytica and vaccines containing same
12 6,610,477	Human DNA mismatch repair proteins
13 6,610,303	Papilloma viruses, products for the detection thereof as well as for treating diseases caused by them
14 6,605,467	Fusion protein comprising the whole or part of the PP65 protein of human CMV, useable in particular for preparing a vaccine
15 6,605,449	Synthetic ligation reassembly in directed evolution
16 6,602,705	Expression of HIV polypeptides and production of virus-like particles
17 6,596,296	Drug releasing biodegradable fiber implant
18 6,593,110	Checkpoint-activating oligonucleotides

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ACLM/"derived from" AND ACLM/transposon: 40 patents.

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PAT. NO.	Title
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- | | | | |
|----|---------------------------|-------------------|---|
| 1 | 6,505,126 | T | Method to identify fungal genes useful as antifungal targets |
| 2 | 6,391,614 | T | Auxiliary gene and protein of methicillin resistant bacteria and antagonists thereof |
| 3 | 6,329,181 | T | Helper functions for recombinant vector production |
| 4 | 6,306,625 | T | Method for obtaining expression of mixed polypeptide particles in yeast |
| 5 | 6,303,381 | T | Insertion sequence |
| 6 | 6,297,031 | T | Escherichia coli strain and method for producing L-threonine |
| 7 | 6,291,214 | T | System for generating recombinant viruses |
| 8 | 6,258,571 | T | High throughput DNA sequencing vector |
| 9 | 6,207,883 | T | DNA sequences coding for a protein conferring male sterility |
| 10 | 6,156,574 | T | Methods of performing gene trapping in bacterial and bacteriophage-derived artificial chromosomes and use thereof |
| 11 | 6,143,530 | T | Circular DNA expression cassettes for in vivo gene transfer |
| 12 | 6,130,090 | T | Methods of performing gene trapping in bacterial and bacteriophage-derived artificial chromosomes and use thereof |
| 13 | 6,096,717 | T | Method for producing tagged genes transcripts and proteins |
| 14 | 5,965,791 | T | Vector for introducing a gene into a plant, and methods for producing transgenic plants and multitudinously introducing genes into a plant using the vector |
| 15 | 5,928,946 | T | Lactic acid bacteria producing lantibiotics similar to nisin A |
| 16 | 5,916,810 | T | Method for producing tagged genes transcripts and proteins |
| 17 | 5,837,509 | T | Recombinant lactic acid bacterium containing an inserted promoter and method of constructing same |
| 18 | 5,830,457 | T | Recombinant beta-lactamase, usable as carrier molecule in immunogenic compositions |
| 19 | 5,804,414 | T | Method of amplifying genes using artificial transposons in coryneform bacteria |

DICTIONARY OF MICROBIOLOGY and MOLECULAR BIOLOGY

Second Edition

Paul Singleton
Diana Sainsbury

A Wiley-Interscience Publication

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*We would like to
Hubert Sainsbury
his passion for
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myalgia Muscle pain.

Myambutol *Syn.* ETHAMBUTOL.

myb An ONCOGENE originally identified as the transforming determinant in avian myeloblastosis virus (AMV; see AVIAN ACUTE LEUKAEMIA VIRUSES); *v-myb* is an altered form of a cellular sequence *amv*, differing from *amv* in gene structure, transcript structure, gene product structure, and in the intracellular location (nucleus) of its product [Book ref. 113, pp. 143–151]. *v-myb*⁺ AMV can transform chicken haematopoietic cells in culture, but differs from other acutely transforming retroviruses in that it does not transform fibroblasts in culture; it causes a rapidly fatal leukaemia only in chickens.

myc. An ONCOGENE originally identified as the transforming determinant of avian myelocytomatosis virus (MC29: see AVIAN ACUTE LEUKAEMIA VIRUSES). The MC29 *v-myc* product is a *gag-myc* fusion protein (P110^{*gag-myc*}) which has no protein kinase activity; it binds to dsDNA and occurs — possibly as a chromatin component — in the nucleus. In humans, *c-myc* is located on chromosome 8 and is involved in the pathogenesis of BURKITT'S LYMPHOMA. In chickens, *c-myc* activation by AVIAN LEUKOSIS VIRUSES appears to result in the development of lymphoid leukaemia.

Mycelia Sterilia See AGONOMYCETALES.

Mycena See AGARICALES (Tricholomataceae)
and BIOLUMINESCENCE.

mycetism (mycetismus) Poisoning due to the ingestion of certain mushrooms (MUSHROOM sense 1) — e.g. the poisonous species of *Amanita* or *Cortinarius*. (cf. MYCOSIS, MYCO-TOXICOSIS; see also e.g. AMATOXINS, MUSCARINE and PHALLOTOXINS.) Mycetism can occur in e.g. sheep and cattle as well as in humans; thus, e.g. the toxins in *Cortinarius speciosissimus* are known to cause renal failure both

mycetismus *Syn.* MYCETISM.

mycetoma (1) *Syn.* MADUROMYCOSIS. (2) (fungus ball) A tumour-like mycelial mass formed in the tissues in certain mycoses (see e.g. ASPERGILLOSIS and COCCIDIOIDOMYCOSIS).

mycetophagous *Syn.* MYCOPHAGOUS.

Mycoacia See
aceae).

Mycobacterium A genus of Gram-positive, aerobic to microaerophilic, non-motile, asporogenous bacteria (order ACTINOMYCETALES, wall type IV) which are acid-fast during at least some stage of growth. Cells: straight or curved rods, ca. $0.2\text{--}0.8 \times 1\text{--}10 \mu\text{m}$, but may occur as coccoid forms, branched rods or fragile filaments; some strains are capsulated (see also MYCOSIDE C). Individual cells may stain uniformly or may exhibit banding or beading. The cells have a type IV cell wall (see ACTINOMYCETALES) which contains MYCOLIC ACIDS (see also CORD FACTOR, WAX D and PEPTIDOGLYCAN). Some strains form carotenoid pigments (see also PHOTOCROMOGEN and SCOTOCROMOGEN).

mycobactins

e.g. does not grow at 42°C; nitrate is not reduced.

M. farcinogenes. SG. Similar to *M. fortuitum* (according e.g. to DNA homology studies). A causal agent of bovine FARCY.

M. flavum. See XANTHOBACTER.

M. fortuitum. RG; non-pigmented. Typically: arylsulphatase +ve; grows at 42°C; Tween hydrolysis variable; nitrate is reduced. [DNA relatedness study of the *M. fortuitum*-*M. chelonae* complex: IJSB (1986) 36 458-460.]

M. haemophilum. SG; non-pigmented. Requires haemin for growth. Grows at 30°C, not at 37°C. One strain; isolated from a skin granuloma.

M. intracellulare. SG; non-pigmented. Similar to *M. avium*, but typically arylsulphatase +ve; catalase (68°C) +ve; grows at 25-40°C (some strains grow at 40-45°C).

M. kansasii. SG; usually photochromogenic. Typically: arylsulphatase +ve; catalase (68°C) +ve; grows at 25-40°C, some strains grow at 42°C; niacin -ve; nitrate is reduced; T2H test +ve; Tween hydrolysis +ve. Can cause tuberculosis-like pulmonary lesions in man.

M. leprae. SG. The causal agent of LEPROSY. Can be cultured e.g. in the footpads of mice but, to date, has not been cultured in cell-free laboratory media. [Review: Book ref. 54, pp. 273-307; various aspects: Ann. Mic. (1982) 133B 5-171.]

M. lepraemurium. SG; non-pigmented. The causal agent of murine leprosy. Limited growth has been reported to occur on egg-yolk media when very large inocula are used.

M. marinum. SG; photochromogenic. Typically: arylsulphatase +ve; catalase (68°C) +ve; grows at 30°C, but can grow at 37°C only after serial subculture; niacin -ve; nitrate not reduced; T2H test +ve; Tween hydrolysis +ve. Causes disease in fish, and skin granulomas in man [Arch. Derm. (1986) 122 698-703]; more common in temperate than in tropical regions (cf. *M. ulcerans*).

M. microti. SG; non-pigmented. Similar to *M. tuberculosis*, but typically gives a variable nitrate reduction test and a negative T2H test.

M. paratuberculosis ('*M. johnei*'). SG; non-pigmented. Typically (few strains examined): catalase (68°C) +ve; niacin -ve; nitrate not reduced; T2H test +ve; Tween hydrolysis variable. (See also MYCOBACTINS.) Causal agent of JOHNE'S DISEASE.

M. phlei. RG; scotochromogenic. Typically: arylsulphatase -ve (at 3 days), variable (at 1 week); grows at 52°C; Tween hydrolysis +ve. Found e.g. in soil and on vegetation; not pathogenic in man.

M. scrofulaceum. SG; scotochromogenic.

Typically: arylsulphatase -ve; catalase (68°C) +ve; grows at 25-42°C; niacin -ve; nitrate not reduced; T2H test +ve; Tween hydrolysis -ve.

M. senegalense. RG; scotochromogenic. A causal agent of bovine FARCY.

M. simiae. SG; some strains photochromogenic, others non-chromogenic. Generally similar to *M. scrofulaceum*, but the niacin test is +ve in some strains.

M. smegmatis. RG; non-pigmented. Typically: arylsulphatase (at 1 week) +ve; grows at 45°C; Tween hydrolysis +ve. Found in smegma; non-pathogenic.

M. thermoresistibile. RG; scotochromogenic. Typically: arylsulphatase -ve; grows at 52°C. Found e.g. in soil.

M. tuberculosis. SG; non-pigmented. Typically: catalase (68°C) -ve; does not grow at 42°C; growth enhanced by glycerol, not by pyruvate; niacin +ve; nitrate is reduced; T2H test +ve; Tween hydrolysis variable. Typically forms rough, raised, whitish/pale buff colonies. A causal agent of TUBERCULOSIS. (cf. *M. microti*.)

M. ulcerans. SG; pigmentation variable. Typically: catalase (68°C) +ve; grows at 30°C but not at 37°C; niacin variable; nitrate not reduced; Tween hydrolysis -ve. Causes BURULI ULCER; found in tropical regions e.g. on vegetation (cf. *M. marinum*).

M. xenopi. SG; pigmentation variable. Similar to *M. avium*, but e.g. does not grow at 25°C, grows poorly at 37°C, and has an optimum growth temperature of ca. 42-45°C. (See also TUBERCULOSIS.)

mycobactins A family of complex, lipophilic compounds which occur in the cell envelope in most species of *Mycobacterium* (not in *M. paratuberculosis* or in some strains of *M. avium*); they chelate trivalent metal ions, particularly solubilized ferric ions, and are believed to function in iron transport — iron being released after enzymic reduction to the ferrous form. For in vitro growth *M. paratuberculosis* needs mycobactin or e.g. ferric ammonium citrate. [Structure of mycobactins: Book ref. 54, pp. 242-245.] (See also EXOCHELINS and SIDEROPHORES.)

Related compounds occur in *Nocardia*.

mycobiont A fungal symbiont — e.g. in a LICHEN or MYCORRHIZA.

Mycobionta Syn. EUMYCOTA.

Mycocalia See NIDULARIALES.

Mycocaliciaceae See CALICIALES.

mycocecidia GALLS induced by fungi.

Mycocentrospora See HYPHOMYCETES; see also CROWN ROT.

mycochrome See PHOTOINDUCTION and PHOTOINHIBITION.

mycodextran Syn. NIGERAN.

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: arylsulphatase -ve; catalase (68°C) +ve; grows at 25-42°C; niacin -ve; nitrate -ve; T2H test +ve; Tween hydrolysis

egalense. RG; scotochromogenic. Agent of bovine FARCY.

iaae. SG; some strains photochromogenic. Others non-chromogenic. Generally *M. scrofulaceum*, but the niacin test some strains.

gmatis. RG; non-pigmented. Typosulphatase (at 1 week) +ve; grows Tween hydrolysis +ve. Found in non-pathogenic.

rmoresistibile. RG; scotochromogenic; arylsulphatase -ve; grows at 25-42°C; niacin -ve; nitrate -ve; T2H test +ve; Tween hydrolysis

rculosis. SG; non-pigmented. Typosulphatase (68°C) -ve; does not grow at 37°C; niacin variable; nitrate not enhanced by glycerol, not by niacin +ve; nitrate is reduced; T2H test +ve; Tween hydrolysis variable. Typis rough, raised, whitish/pale buff

causal agent of TUBERCULOSIS. (cf. *M. tuberculosis*.)

rans. SG; pigmentation variable. catalase (68°C) +ve; grows at 30-37°C; niacin variable; nitrate not enhanced by glycerol, not by niacin +ve; nitrate is reduced; T2H test +ve; Tween hydrolysis

pi. SG; pigmentation variable. *M. avium*, but e.g. does not grow at 37°C, and has an optimum growth temperature of ca. 42-45°C. (cf. *M. marinum*.)

A family of complex, lipophilic bacteria which occur in the cell envelopes of *Mycobacterium* (not in *M. tuberculosis* or in some strains of *M. tuberculosis*) which chelate trivalent metal ions, particularly ferric ions, and are involved in iron transport — iron reduction after enzymic reduction to the ferrous state. For in vitro growth *M. paratuberculosis* needs mycobactin or e.g. ferric citrate. [Structure of mycobactins: JGM (1983) 129 889-891; (1984) 130 363-367, 2733-2736.] (See also EXOSIDEROPHORES.)

Compounds occur in *Nocardia*. Fungal symbiont — e.g. in a *YCORRHIZA*.

yn. EUMYCOTA.

2. NIDULARIALES.

e. See CALICIALES.

alls induced by fungi.

a. See HYPHOMYCETES; see also

See PHOTOINDUCTION and PHOTO

Syn. NIGERAN.

Mycogone. See HYPHOMYCETES; see also BUBBLE DISEASES.

mycoherbicide. See BIOLOGICAL CONTROL.

mycolic acids α -Substituted, β -hydroxylated fatty acids (having the general formula $R'CHOH.CHR''COOH$), esters of which are found in the cell walls of e.g. species of *Corynebacterium*, *Mycobacterium*, *Nocardia*, and *Rhodococcus*; in *Mycobacterium* spp the mycolic acids fall within the approximate range C_{60} - C_{90} , in *Nocardia* C_{40} - C_{60} , and in *Corynebacterium* C_{20} - C_{40} .

In mycobacterial mycolic acids R' is usually a C_{50} - C_{60} chain which often includes double bonds, cyclopropane rings etc, while R'' is a C_{22} - C_{24} chain. [Structure and biosynthesis: Book ref. 54, pp.113-128. Mycolic acid patterns in various strains of *Mycobacterium*: JGM (1983) 129 889-891; (1984) 130 363-367, 2733-2736.] (See also WAX D.)

[Mycolic acids in *Corynebacterium* spp: JGM (1984) 130 513-519.]

mycology. The study of FUNGI.

mycoparasite. A fungus which is parasitic on other fungi. Mycoparasites include e.g. *Christiansenia pallida* [life history: Mycol. (1984) 76 9-22]; *PIPTOCEPHALIS*; and *Rozella* spp: endobiotic and holocarpic organisms which parasitize e.g. *Polypogon euglenae* (itself a parasite of *Euglena* spp) [Mycol. (1984) 76 1039-1048] and other fungi and algae. Some mycoparasites can apparently exert some control on pathogens of higher plants — e.g., in cases of CLOVER ROT, *Trichoderma viride* (or e.g. *Mitrella sclerotiorum*) can bring about a reduction of the numbers of sclerotia in the soil [Bot. Rev. (1984) 50 491-504] [Susceptibility of e.g. *Pythium* spp to the mycoparasite *Pythium oligandrum*: SBB (1986) 18 91-96.] (See also CONTACT BIOTROPIC MYCOPARASITE.)

mycophagous (mycetophagous). Fungus-eating. e.g. by *Penicillium brevicompactum* in aerial hyphae formed on solid media [AEM (1981) 41 729-736]. It has antimicrobial and antitumour activity, blocking GMP synthesis by inhibiting the formation of XMP from IMP (see Appendix V(a)).

Mycoplana. A genus of Gram-negative, aerobic bacteria of uncertain taxonomic affinity; species occur e.g. in soil. The organisms form branching filaments which fragment into irregular, flagellated rods. Some strains can fix nitrogen under microaerobic conditions [JGM (1982) 128 2073-2080]. GC%: ca. 64-69. [Book ref. 46, pp. 2118-2119.]

mycoplasma (1) A member of the class MOLLICUTES. (cf. MOLLICUTE.) (2) A member of the genus MYCOPLASMA.

Mycoplasma. A genus of cell wall-less, sterol-requiring, catalase-negative bacteria (family

Mycoplasma

MYCOPLASMATACEAE) which occur as parasites and pathogens e.g. in the respiratory and urogenital tracts in man and other animals; diseases caused by, or associated with, *Mycoplasma* spp include e.g. AIR SACCULITIS, BRONCHITIS, CONTAGIOUS BOVINE PLEUROPNEUMONIA, GLASSER'S DISEASE, NON-GONOCOCCAL URETHRITIS, ovine MASTITIS, and PRIMARY ATYPICAL PNEUMONIA (sense 2). (*Mycoplasma* spp are also common contaminants in TISSUE CULTURES.) Cells: typically non-motile (but see below) and pleomorphic, ranging from spherical, ovoid or pear-shaped (ca. 0.3-0.8 μ m diam.) to branched filamentous forms of near-uniform diameter, several μ m to ca. 150 μ m in length; filaments, the typical forms in young cultures under optimum conditions, subsequently transform into chains of coccoid cells which later break up into individual cells that are capable of passing through membrane filters of pore size 0.22 μ m or 0.45 μ m. The cells of some species have a 'tip' structure (possibly part of a microfibrillar 'cytoskeleton') which may be involved in attachment to host cells, and which (in motile species) appears to have a role in GLIDING MOTILITY — the tip always pointing in the direction of motion.

The trilaminar cytoplasmic membrane contains sterols (in addition to e.g. phospholipids and proteins) — thus rendering the cells susceptible to POLYENE ANTIBIOTICS and to lysis by e.g. digitonin (which complexes sterols). Some species bear a capsule or slime layer — that in *M. mycoides* subsp. *mycoides* being a galactan.

Replication of the genome may precede cytoplasmic division; hence, 'multinucleate' filaments may exist for a time before individual cells are delimited by constriction. Budding can also occur.

Most *Mycoplasma* spp are facultatively anaerobic, some apparently being obligately anaerobic on primary isolation. All species are chemoorganotrophic. 'Fermentative' species can use sugars such as glucose (metabolized to e.g. lactic acid via the EMP pathway), while 'non-fermentative' species can use e.g. arginine. All species need cholesterol or related sterols (e.g. cholestanol or stigmastanol). The organisms have a flavin-terminated electron transport chain which lacks both quinones and cytochromes. NADH oxidase occurs in the cytoplasm (cf. ACHOLEPLASMA). Growth occurs on complex media (e.g. HAYFLICK MEDIUM); fastidious mycoplasmas may be grown on diphasic SP-4 medium [recipe: Book ref. 22, p. 746]. Colonies (usually <1 mm diam.) are typically of the 'fried egg' type: an opaque, granular central region, embedded in the agar, surrounded by non-

mycoplasma virus type 1 phages

granular surface growth. Optimum growth temperature of mammalian strains: 36–37°C. Many species produce weak or clear haemolysis; haemolysis appears to be due to the secretion of H_2O_2 (a product which is believed to account for some aspects of pathogenicity). Mycoplasmas are commonly sensitive to chloramphenicol and to tetracyclines; most species can tolerate 1:2000/4000 thallos acetate. Broth cultures of *Mycoplasma* spp (supplemented with DMSO or glycerol) can be stored at -70°C; alternatively, broth cultures may be lyophilized. GC%: ca. 23–40. Type species: *M. mycoides*.

The genus currently contains over 60 species which are differentiated on the basis of certain tests: e.g., utilization of glucose and mannose, arginine hydrolysis, phosphatase production, the FILM AND SPOTS reaction, and haemadsorption.

M. glycyphilum. A new avian species [JGM (1984) 130 597–603].

M. laidlawii. Re-classified as *Acholeplasma laidlawii*.

M. mycoides. Non-motile cells which often form repeatedly branching filaments. Under certain conditions a culture may contain cells called *rho*-forms; a *rho*-form contains an intracellular organelle (function unknown) which consists essentially of an axial fibre (ca. 40–120 nm diam.) extending the length of the cell and occupying a major part of the cell's volume. *M. mycoides* subsp. *mycoides* causes contagious bovine pleuropneumonia.

M. pneumoniae (Eaton's agent). A slowly-growing species which causes a primary atypical pneumonia in man. On primary isolation, the colonies (after 5–10 days' incubation) are ca. 50–100 µm in diameter and are entirely granular, i.e., they are not typical 'fried egg' colonies; fried egg colonies generally develop on subculture. The organisms are generally highly sensitive to erythromycin.

T-strain mycoplasmas. See UREAPLASMA.

[Book ref. 22, pp. 742–770. *Mycoplasma* characterization: Book ref. 98. *Mycoplasma* evolutionary tree from 5S rRNA sequencing data: PNAS (1985) 82 1160–1164.]

(See also MYCOPLASMIVIRUSES.)

mycoplasma virus type 1 phages Syn. PLECTROVIRUS.

mycoplasma virus type 2 phages Syn. PLASMIVIRIDAE.

Mycoplasmataceae A family of non-helical, sterol-requiring, cell wall-less bacteria of the order MYCOPLASMATALES. Two genera: MYCOPLASMA (urease-negative) and UREAPLASMA (urease-positive).

Mycoplasmatales An order of cell wall-less bacteria of the class MOLLICUTES; it comprises three families: MYCOPLASMATACEAE (non-heli-

cal cells which require sterols for growth), ACHOLEPLASMATACEAE (non-helical cells which do not require sterols), and SPIROPLASMATACEAE (cells often helical; sterols required for growth). [Book ref. 22, pp. 741–787.]

mycoplasmaviruses BACTERIOPHAGES which infect members of the MYCOPLASMATALES: see MV-L3 PHAGE GROUP, PLASMIVIRIDAE, PLECTROVIRUS, SPIROPLASMIVIRUSES. [Review: Intervirology (1982) 18 177–188.]

mycoplasmosis Any disease caused by a species of MYCOPLASMA (q.v.)

mycorrhiza A stable, usually mutualistic association between a fungus and the root (or rhizoid) of a plant. Mycorrhizas occur in the majority of plants, including vascular and some non-vascular species (e.g. liverworts). The fungi involved (e.g. basidiomycetes, ascomycetes, deuteromycetes) are always associated with the primary cortex of the root, and many appear never to occur as free-living saprotrophs. The formation of mycorrhizas leads to improved uptake of nutrients by the host plant; nutrients are apparently absorbed by hyphae (which may extend some distance from the root) and are transported back to the root to be released into the host tissue. Mycorrhiza formation and efficacy is greatest in nutrient-poor soils, and may be reduced or eliminated by application of soil fertilizers. Three major types of mycorrhiza are recognized.

Ectomycorrhizas ('ectotrophic mycorrhizas') occur mainly in temperate forest trees; the fungi involved include basidiomycetes (e.g. agarics, boletes), ascomycetes (e.g. *Tuber* spp) and zygomycetes (*Endogone*). A given tree may associate with more than one species of fungus. In an ectomycorrhiza the fungal hyphae occur on the root surface and may penetrate between the cortical cells of the root, but the cortical cells themselves are not penetrated. Typically, the host root becomes completely enclosed by a sheath of pseudoparenchymal fungal tissue (the *mantle*); hyphae from the mantle may penetrate the soil surrounding the root and also penetrate between the cortical cells of the root to enmesh individual cortical cells in a network of hyphae (the *Hartig net*). The root is morphologically distinct from an uninfected root: e.g., it lacks root hairs and a root cap; it is thicker than an uninfected root and may be a different colour; it may branch extensively and characteristically — e.g. pinnately (in *Fagus* spp) or dichotomously (in *Pinus* spp) — or not at all (e.g. in *Quercus* spp). In certain cases an ectomycorrhiza may develop in the form of nodules (= tubercles), each consisting of a rounded, dense mass of mycorrhizal roots.